generate more than $8 million in annual revenues—also in excess of Comsat revenues for occasional-use and short-term video services.

Columbia actively promotes occasional-use service and stresses economical pricing, flexible terms, and bandwidth as required. The company notes that customers can arrange for occasional-use video service (with a minimum commitment time of 15 minutes) to Asia, the U.S., Europe, and Africa through its 24-hour video booking center.[102] For occasional-use video service, Columbia uses at least three transponders on the TDRS-4 and TDRS-5 satellites.[103] At an average fill rate of 25 to 50 percent and charges of $125,000 per month, this translates into annual revenues of $1.1 million to $2.3 million. According to company accounts, during the 1996 Olympic Games in Atlanta, Columbia had fully booked its entire capacity on all three satellites (including TDRS-6).[104] Also, several of Columbia full-time transponders are leased to resellers of video services such as TRW.[105]

In addition, Intersputnik provides world-wide occasional-use video service (with a 10-minute minimum commitment period) and stresses that it follows closely the world level of prices for its services.[106] Hispasat promotes a full spectrum of short-time and occasional-use services (e.g., satellite news gathering with 10 minute minimum commitment period) in and between Spain, North America, and South America.[107] And occasional-use video service on fiber optic cables is now also available between the video fiber networks in the U.S., Canada, and the U.K., and is scheduled to become available to continental Europe, Japan and Singapore in the near future.[108]

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[102] Columbia Communications Corporation, Presentation, ISOG '95 Conference, Hong Kong, November 7, 1995.

[103] DaiLink SatCom, Ltd., *Transponder Loading Database*, Vienna, VA, April 30, 1996.

[104] Telephone conversation with Mike Fowler at Columbia Communications, September 10, 1996.

[105] DaiLink SatCom, Ltd., *Transponder Loading Database*, Vienna, VA, April 30, 1996.

[106] *Intersputnik User Handbook*, Moscow, 1995, pp. 61-62.

[107] Hispasat, Sistema Español de Communicaciones por Satelite, Brochure.

[108] "AtlanticVision: Transatlantic Fiber Video Services," Brochure, Vyvx, Tulsa, Oklahoma, 1995; "NAB Notebook," *Communications Daily*, April 18, 1996; Telephone conversation with Anu Krishanswamy, Vyvx. Most major broadcasters (e.g., CNN, HBO, NBC, ABC, and the BBC) are already among the (continued...)

Competitive pressure on providers of occasional-use and short-term service is further enhanced by resellers and packagers (such as IDB and Keystone) of full-time transponder capacity. If Comsat or one of its direct competitors tried to raise prices for occasional-use video services above competitive levels, these resellers would likely arbitrage away any uneconomic differences between full-time and occasional-use prices. Given the number of competing providers in the occasional-use and short-term video markets that have emerged over the last few years, the size and sophistication of customers, and the fact that Comsat's revenues from occasional-use and short-term service amount only to $5.5 million per year, the concerns about occasional-use video service raised in the FCC's Partial Relief Order no longer apply.

VI. CONCLUSIONS

Based on the market data that has become available since our 1994 Study, we conclude that Comsat's provision of Intelsat video space segment services to and from the United States faces effective competition in all geographic market segments. In recent years, Comsat has seen an erosion of its market share that appears unprecedented in the telecommunications industry. Additional competitive factors—such as the pace of satellite launches and entry by new competitors, presubscription of planned facilities, the extent of unutilized capacity of partly-presubscribed satellites, sophistication and bargaining power of video customers, and Comsat's competitive handicaps—are certain to further erode Comsat's video market shares and competitive position. Given the level of effective competition that exists today, Comsat would be unable to exercise market power in the provision of Intelsat video and audio space segment services. Comsat is no longer the dominant carrier in video services, and the regulatory burden imposed on Comsat—but not on its competitors—has lost its economic justification.

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[108] (...continued)
customers for Vyvx's transatlantic fiber video service. Also, the BBC signed up for dedicated video service between Atlanta and the U.K. to transmit footage from the 1996 Olympic Games.

ABOUT THE AUTHORS

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Hendrik S. Houthakker is a senior advisor to The Brattle Group and the Henry Lee Professor of Economics Emeritus at Harvard University. Since joining the Harvard faculty in 1960, he has worked in a number of areas, including economic theory, econometrics and economic policy. Professor Houthakker has applied econometric techniques to consumer demand, international economic relations, and commodity markets. From 1971 to 1992 he was Editor of *The Review of Economics and Statistics*. In 1987-88 he was Acting Chairperson of the department.

Professor Houthakker served as one of the three members of President Nixon's Council of Economic Advisers from 1969 to 1971. Previously, he had served on the staff of President Johnson's Council of Economic Advisers. He has been a consultant to several government agencies and private organizations, and a member of the National Commission on Supplies and Shortages (1975-77).

Professor Houthakker completed his graduate work at the University of Amsterdam in 1949. After conducting economic research at Cambridge University (1949-51), he started teaching at the University of Chicago (1952-53). Prior to joining the Harvard faculty in 1960, he also taught at Stanford University (1954-60) and was Visiting Professor at the University of Tokyo (1955), at M.I.T. (1957-58) and at Harvard (1958-59).

With S.J. Prais, he is coauthor of "The Analysis of Family Budgets" (1955). His monograph, "Consumer Demand in the United States, 1929-1970," with Lester D. Taylor, was published in 1966; a second and enlarged edition appeared in 1970. Two other monographs are "Economic Policy for the Farm Sector" (1967) and "The World Price of Oil" (1976). A recent book, "The Economics of Financial Markets," with Peter J. Williamson, was published in 1996. He has also written numerous articles.

Professor Houthakker is a member of the National Academy of Sciences, the American Academy of Arts and Sciences and the American Economic Association (AEA), from which he received the John Bates Clark medal in 1963; he was a Vice President of the AEA in 1972. He is a Fellow of the Econometric Society, of which he was President in 1967, and corresponding member of the Royal Netherlands Academy of Sciences. He has received honorary doctorates from the University of Amsterdam and the University of Fribourg, and is an Adjunct Scholar of the American Enterprise Institute.

The Brattle Group

The Brattle Group provides economic, management, and environmental counsel throughout the U.S. and abroad. Clients include major corporations, law firms, trade associations, and government agencies. *The Brattle Group*'s practice focuses on providing assistance to corporations and their legal counsel in the areas of regulated industries, antitrust and transportation economics, finance, damage assessment, technology and R&D management, and energy and environmental issues. Members of *The Brattle Group* have provided economic counsel and have been expert witnesses in many of the major litigation efforts of the past decade. Assignments have involved numerous industries such as telecommunications, airlines, railroads, ocean shipping, natural gas and electric utilities, pipelines and natural resources. *The Brattle Group*'s analyses in this study were performed by Johannes P. Pfeifenberger and William B. Tye.

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WILLIAM B. TYE is a Principal at *The Brattle Group.* He received a B.A. in economics from Emory University and a Ph.D. in economics from Harvard University in 1969. Since teaching economics for three years at United States Air Force Academy, he has been working as an economic consultant. In August 1990, he formed *The Brattle Group* with five colleagues. Much of his consulting career has involved regulated industries. He has testified before numerous regulatory agencies and courts involving issues of rates, economics, management, and competition. Dr. Tye has authored or co-authored over 100 papers and publications, including four books on regulated industries. The books include *Regulatory Risk: Economic Principles and Applications to Natural Gas Pipelines and Other Industries* (Kluwer Academic Publishers, 1993) and *The Transition to Deregulation* (Quorum Books, 1991). The papers have appeared in such publications as *The American Economic Review*, *The Yale Journal on Regulation*, *Energy Law Journal*, *The Rand Journal of Economics*, and *Public Utilities Fortnightly*. He speaks frequently at seminars and meetings on regulatory issues sponsored by organizations such as the National Association of Regulatory Utility Commissioners, the Federal Energy Bar Association, and the Antitrust Section of the American Bar Association.

APPENDIX A

APPENDIX A

QUANTITATIVE ANALYSIS

This Appendix presents our numerical results and describes the measurement of market size and the definition of market segments used to estimate Comsat's shares of video services to and from the U.S.

Measurement of Market Size

Customers of transoceanic video services *use* (i.e., lease) transponder capacity on competing satellite systems. Thus, market volume is measured as the amount of *utilized* transponder capacity. Because the standard transponder size for the transmission of a broadcast-quality analog video transmission generally is either 27 MHz or 36 MHz of bandwidth (depending on satellite configuration and signal strength), utilized capacity is quantified as the number of 27/36 MHz-equivalent transponder leases. A 54 MHz or 72 MHz transponder lease thus is equivalent to two 27/36 MHz transponder leases.

This study does not include the gains of digital compression in the measure of capacity available to (or utilized for) facilities-based service. By means of digital compression, customers of video services are able to "pack" up to six broadcast-quality video channels into one 27/36 MHz-equivalent transponder. Exclusion of capacity derived through digital compression is appropriate because Comsat competes in the market providing physical transoceanic facilities-based telecommunications capacity and it is largely up to the customer to decide whether or not to use digital compression. However, to the extent that digital compression allows video customers to lease only fractions of 27/36 MHz-equivalent transponders for the transmission of a single broadcast-quality video channel, the impact of digital compression is a reduction of transponder leases and lower satellite utilization.

Market Segments

The analysis focuses on the market for video and audio services to and from the U.S. along major geographic routes. Services include occasional-use, short-term, and full-time video leases. Today, competitors of Comsat provide a full range of video services on a world-wide basis. Because satellite capacity can be used to provide any type of video transmission, there is significant supply elasticity in the provision of individual types of services. For example,

a number of video customers of Comsat and its competitors lease full-time satellite capacity in order to resell that capacity on an occasional-use basis. Individual video service segments are, thus, not differentiated in the analysis of market shares.

Comsat and its competitors provide video services on a regional, inter-regional, or global basis. The point-to-multipoint nature of many video services, and the operational flexibility that satellites offer,[109] call for a regional definition of geographic market segments.[110] Unlike with terrestrial facilities, such as cables or microwave links, space segment transponder capacity and transmission signals are available to the entire geographic region covered by a satellite's transmission beams.

Three geographic areas (associated with major land-masses) are typically used to define *regional* satellite service: the Americas and the Caribbean; Europe, the Middle East, and Africa; and Asia and the Pacific. To provide various *transoceanic* services, satellites need to be in orbits between these land masses.[111] The coverage areas of transoceanic satellites usually are referred to as ocean regions: the Atlantic-Ocean Region (AOR), the Pacific-Ocean Region (POR), and the Indian-Ocean Region (IOR). AOR satellites can provide services within or between the Americas/Caribbean and Europe/Middle-East/Africa; POR satellites can provide services within or between the Americas/Caribbean and Asia/Pacific;

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[109] The FCC has recognized the operational flexibility of satellites in the Partial Relief Order (¶s 29, 31, 33).

[110] Video services frequently are provided to a number of receiving points on a region-wide basis. This regional character of video services is in stark contrast to switched voice services, which are provided exclusively on a point-to-point basis between individual countries.

Furthermore, a regional definition of video service markets is appropriate because countries generally do not restrict entry into the provision of video space segment. As PanAmSat notes, for example, "national telecommunications authorities have not typically required the Company to obtain licenses or regulatory authorizations in order to provide space segment capacity to licensed entities [of those countries]." Significantly, PanAmSat further explains that "[m]any countries allow licensed radio and television broadcasters and cable television operators to own their own transmission broadcast facilities and purchase satellite capacity without restriction" (PanAmSat, *Prospectus*, September 25, 1995, p. 63). Similarly, Intelsat has greatly simplified the consultation process under Article XIV(d) of the Intelsat Agreement and, as the FCC has recognized (File I-T-C-92-164, n. 12), no longer requires country-by-country consultations.

Also note that no U.S. satellite system licensee is required to file telecommunications traffic statistics in any form. Thus, a country-by-country analysis of video service would not only be unnecessary because of the regional nature of this market, but also be extremely difficult (if not impossible) due to the lack of data.

[111] Note, however, that this is not necessary for global or multi-regional satellite systems with inter-satellite links.

and IOR satellites can provide services within or between Europe/Middle East/Africa and Asia/Pacific. IOR satellites generally are in orbital positions that do not allow direct uplink or downlink from the U.S.

The three major geographic market segments used for analyzing transoceanic video service to and from the U.S. include the following routes:

(1) across the Atlantic to Europe/Middle East/Africa ("trans-Atlantic");

(2) across the Pacific to Asia/Oceania ("trans-Pacific"); and

(3) intra-regional transmission between the U.S. and the Caribbean and Latin America ("Latin America").

Note, however, that video customers with global service requirements are able to substitute trans-Atlantic service for trans-Pacific service (and *vice versa*).[112]

Data and Analyses

Comprehensive and consistent time-series data of transponder utilization for video services to and from the U.S. (that would ordinarily form the basis for an analysis of market shares and market share trends) could not be identified. None of Comsat's competitors is required to file tariffs or traffic statistics and the fast pace of change makes it generally difficult to obtain consistent, up-to-date industry data. This study draws upon a large number of sources to estimate the transponder utilization data necessary to present a complete analysis of shares and trends in the market for transoceanic facilities-based video services to and from the U.S.

In addition to end-of-year transponder utilization (**Table SUM-1**) and utilization shares (**Table SUM-2**) for transoceanic video leases, the tables in this Appendix also provide estimates for transoceanic video revenues (**Table REV-1**) and revenue shares (**Table REV-2**). Projections in the 1994 Study projected significant differences between Comsat's share of transponder utilization and revenues for transoceanic video service. This study, however, only finds small differences between utilization shares and revenue shares and, thus, focuses mainly on utilization shares.

[112] See discussion in Section IV, "Convergence of Market Segments."

Comsat

Historical data and 1996 projections[113] of Comsat annual revenues and year-end full-period video and audio transponder leases were provided by Comsat for service across the Atlantic, the Pacific, and to Latin America. Comsat also provided annual revenues for short-term and occasional-use video service. Year-end full-period video and audio transponder leases for the three geographic routes were adjusted to include the full-time equivalent transponder utilization for short-term and occasional-use video services. (See **Table COM-1**).

PanAmSat and Orion

Video transponder leases to and from the U.S. for PanAmSat and Orion were developed for individual satellites through a bottom-up modeling of the companies' capacity utilization on those satellites calibrated to generate the companies' actual video revenues for 1993-1995 and the revenue projections for 1996. This modeling process sequentially quantified for each satellite operational by mid 1996 (1) total available capacity; (2) total utilized capacity; (3) capacity utilized for video services; and (4) video capacity utilized for services to and from the U.S.:

- Satellite technical specifications and launch dates (see **Tables PAN-1** and **ORI-1**) were used to determine the total number of transponders available for each year from 1993 through 1997.
- The annual average number of total *utilized* transponders was estimated based on expected pre-subscription rates and utilization targets for individual satellites for the years 1993 through 1997. (See **Tables PAN-2** and **Orion-2**). These estimates of each company's annual capacity utilization were calibrated (based on estimates of each company's average transponder revenues for its services) to be consistent with the companies' annual revenues.[114]
- The number of transponders *utilized for video services* was estimated based on the companies' (1) share of video revenues relative to total

[113] Based on the first 8 months of 1996.

[114] Note that the revenues from single-satellite systems (PAS-1 in 1993, and Orion 1) are equal to revenues from the individual satellite.

revenues;[115] and (2) the companies' average revenue per transponder for video and other (switched voice and private line) services (See **Tables PAN-3, PAN-4** and **ORI-3, ORI-4**).

- The *fraction* of video transponders utilized *for services to and from the U.S.* was estimated based on (1) satellite coverage areas (see Tables PAS-1 and ORI-1); (2) a database of currently identified video transponder leases for Orion 1, PAS-1, PAS-2, and PAS-3;[116] and (3) information from various other public sources (see **Tables PAN-6** and **ORI-6**).[117]
- For each of the companies' satellites, the estimated average number of transponders *utilized for video services to and from the U.S.* for the years 1994-1997 was estimated by multiplying total utilized transponders for video services on each satellite with the fraction of video transponders utilized for services to and from the U.S. Average video transponder leases to and from the U.S. were then adjusted to reflect end-of-year values for 1993-1996. (See **Tables PAN-7** and **ORI-7**).

Total revenues and revenues from video services calculated from the utilization models for PanAmSat and Orion (by multiplying utilized transponders with average revenues per transponder for video and other services), generate revenues consistent with publicly-available revenue data for the two companies (see **Tables PAN-5** and **ORI-5**). Modeled video transponder utilization estimates for Orion 1, PAS-1, PAS-2, and PAS-3R also correspond well to the assembled database of currently identified video transponder leases.[118]

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[115] The share of video revenues for 1997 was assumed equal to the share of video revenues in 1996.

[116] Sources: DaiLink SatCom, Ltd., *Transponder Loading Database*, Vienna, VA, April 30, 1996; DaiLink SatCom, Ltd, *Transponder Loading Database—PanAmSat* Update, Vienna, VA, September 11, 1996.

[117] Table from *Variety*, faxed on March 20, 1996; PanAmSat and Orion financial literature; Trade Press.

[118] Note, however, that the database of currently identified satellite transponder leases may be neither complete nor up-to-date. Thus, it is only used to estimate the fraction of video transponder leases that is used for services to and from the U.S.

PanAmSat 1996 revenues were estimated by doubling revenues for the first two quarters of 1996. The resulting estimates exceed PanAmSat's 1993 forecasts,[119] but are less than analyst revenue forecasts of $270 million[120] and less than 1995 revenues increased at the same-period growth rate for the first two quarters of 1995 and 1996. Orion 1996 revenues were projected based on the same period growth rate for the first to quarter of 1995 and 1996—resulting in estimates that are below Orion's own 1995 forecasts.[121] (See **Tables PAN-5a and ORI-5a**).

Columbia Communications

For trans-Atlantic and trans-Pacific satellite services, Columbia Communications has been making available 12 transponders on each of NASA's TDRS-4 and TDRS-5 trans-Atlantic and trans-Pacific satellites. Most recently, Columbia has also started to offer satellite capacity on NASA's TDRS-6 satellite. Average 1996 video transponder leases to and from the U.S. was estimated for TDRS-4 and TDRS-5 based on *DaiLink SatCom*'s current transponder loading database. (See **Table COL-1**). Reportedly, TDRS-6 was fully booked with short-term service during the Olympic Games in Atlanta. Only the full-time equivalent of a 3-week short-term service was used to estimate average 1996 utilization of that satellite. Average 1993-1997 video transponder leases to and from the U.S. were linearly interpolated starting from zero in 1991 (TDRS-4), 1992 (TDRS-5), and 1996 (TDRS-6). These estimates were then adjusted to reflect end-of-year values for 1993-1996 (See **Table COL-2**).

Intersputnik

In 1995, the FCC gave a number of U.S. firms blanket authority to use five Russian satellites for telephone, business, and video transmissions between the U.S. and the countries of the former Soviet Union (*FCC*, File No. I-T-C-92-164, July 5, 1995). Based on this FCC decision, a number of video leases (to and from the U.S.) were identified for individual Russian satellites. Only this lease information was used as the estimate of Intersputnik end-of-year utilized video transponders for 1995 and 1996. (See **Table INT-1**). No other video leases were included.

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[119] PanAmSat, SEC Form S-1, May 25, 1993, p. A-7.

[120] *The Wall Street Journal*, "PanAmSat's Suitors include GE, Loral, GM's Hughes, June 14, p. B4.

[121] Orion Network Systems, *Prospectus*, June 27, 1995, p. 13.

Galaxy Latin America

Hughes' Galaxy Latin America satellite system is aggressively expanding video service to Latin America. Hughes has been able to provide transborder satellite service to Canada, the Caribbean, and Central America for a number of years. With the 1995 launch of its Galaxy IIIR satellite, the company has expanded its coverage area to Latin America. Twenty-four video transponders on this satellite now provide 144 channels of programming to all of South and Central America. End-of-year 1996 video transponders from the U.S. are based on the information that 60 channels are uplinked from the U.S. Average 1996 transponder utilization was estimated based on a half year of operation. (See **Table GLA-1**).

Hispasat

Hispasat reports that it transmits Spanish TV broadcasting to the U.S. and the rest of North and South America via two transponders. The Study assumes that these two transponders have been utilized for service to the U.S. since 1995 and are the satellite system's only transoceanic video service. (See Hispasat entry in **Table SUM-1**).

Other Domestic and Regional Satellite Systems

A number of domestic satellite systems are able to provide video service to and from the U.S. For example, in addition to Hughes, virtually all other U.S. domestic satellite systems also cover Canada, the Caribbean, and Central America. The Canadian, Mexican, and Argentine satellite systems also cover large parts of the U.S. Similarly, the French Telecom and Japanese JCSAT satellites are able to provide transoceanic service to and from the U.S. (see Section II). Within the framework of this report, reliable data of dedicated transponder leases to and from the U.S. could not be identified for these satellite systems. Competition from these systems therefore is not reflected in estimated market shares.

Fiber Video Service

Video service via fiber optic cables is available between the U.S., Canada, and the U.K.[122] However, due to limited information about the utilization of fiber video service to and from the U.S., fiber video service is not included in the estimates of Comsat's market share.

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[122] See Section II of this report.

Video Revenues

Video revenue estimates for the U.S. half-circuit are summarized in **Table REV-1**. Comsat provided annual revenues for video and audio (incl. occasional-use and short-term) service and end-of-year allocations by geographic route. Video revenues for the U.S. half circuit for PanAmSat, Orion, Galaxy Latin America, Columbia, and Intersputnik were estimated based on individual satellites' average annual transponder utilization for service to and from the U.S. and half of the systems' estimated average transponder rates. Average transponder rates for PanAmSat and Orion are listed in Tables PAS-3 and ORI-3. The average transponder rate for Galaxy Latin America is assumed equal to PanAmSat's average rate for Ku-band service. The average rate for Columbia, Intersputnik, and Hispasat is assumed to be $1.2 million per year for each 27/36 MHz-equivalent full-time equivalent transponder. Comsat's share of video revenues for services to and from the U.S. are summarized in **Table REV-2**. (Note that revenue shares are derived from *average-year* transponder utilizations and, thus, do not strictly correspond to the *end-of-year* transponder utilization shares reported in Table SUM-2).

Unutilized Capacity

Average annual unutilized capacity on currently operational PanAmSat, Orion, and Columbia satellites in the AOR and POR is estimated for the years 1993-1997 as the difference between each satellite's total capacity and the satellite's total utilized capacity (including private line and switched voice utilization). Average-year unutilized capacity was adjusted to reflect end-of-year estimates. (See **Table UNUT-1**).

NUMERICAL RESULTS

List of Tables

Columbia Communications

Intersputnik

Galaxy Latin America

Video Revenues

Unutilized Satellite Capacity

Transponder Utilization Summaries

Table SUM-1. Utilized Video Transponder Leases to and from the U.S.
(Including Audio and Occasional-Use/Short-Term Video)

Region		End of Year 27/36 MHz-Equivalent Transponders 1993	1994	1995	1996*
Trans-Atlantic	[1]	53.1	55.2	76.4	78.6
Comsat	[2]	43.8	44.8	48.8	41.5
PAS-1	[3]	6.9	7.4	8.0	7.1
PAS-3R	[4]				4.0
Orion-1	[5]			8.0	12.6
Columbia/TDRS 4	[6]	2.3	3.0	3.7	4.3
Columbia/TDRS 6	[7]				1.0
Intersputnik	[8]			6.0	6.0
Hispasat	[9]			2.0	2.0
Telecom	[10]				
Fiber-Optic Cables	[11]				
Latin America	[12]	18.8	22.2	20.3	51.2
Comsat	[13]	10.2	13.0	10.4	12.9
PAS-1	[14]	8.7	9.2	9.9	8.8
PAS-3R	[15]				16.2
Intersputnik	[16]				
Hispasat	[17]				
Hughes GLA	[18]				13.3
U.S. Domsats	[19]				
Solidaridad/Morelos	[20]				
Anik	[21]				
Nahuelsat	[22]				
Fiber-Optic Cables	[23]				
Trans-Pacific	[24]	22.3	27.7	30.9	32.9
Comsat	[25]	21.5	21.1	16.0	14.3
PAS-2	[26]		5.2	10.9	14.0
Columbia/TDRS 5	[27]	0.8	1.4	2.0	2.5
Intersputnik	[28]			2.0	2.0
JCSAT	[29]				
Fiber-Optic Cables	[30]				
Total for All Regions	[31]	94.3	105.1	127.6	162.7
Comsat	[32]	75.5	78.8	75.2	68.8
PanAmSat	[33]	15.6	21.9	28.8	50.1
Orion	[34]			8.0	12.6
Columbia	[35]	3.2	4.4	5.6	7.9
Intersputnik	[36]			8.0	8.0
Hispasat	[37]			2.0	2.0
Telecom	[38]				
Hughes GLA	[39]				13.3
U.S. Domsats	[40]				
Solidaridad/Morelos	[41]				
Anik	[42]				
Nahuelsat	[43]				
JCSAT	[44]				
Fiber-Optic Cables	[45]				

Notes to Table SUM-1:

*1996 Estimate based on extrapolation of partial-year data.

[1], [12], [24]	Total for region.
[2], [13], [25]	See Table COM-1.
[3], [4], [14], [15], [26]	See Table PAN-7.
[5]	See Table ORI-7.
[6], [7], [27]	See Table COL-2.
[8], [16], [28]	See Table INT-1.
[9]	Hispasat, "Canales de TV y radio para América," May 1996.
[18]	See Table GLA-1.

Table SUM-2. Market Share of Utilized Video Transponder Leases to and from the U.S.
(Including Audio and Occasional-Use/Short-Term Video)

Region	[Notes]	End of Year 1993	1994	1995	1996*
Trans-Atlantic	[1]	100%	100%	100%	100%
Comsat	[2]	83%	81%	64%	53%
PAS-1	[3]	13%	13%	10%	9%
PAS-3R	[4]				5%
Orion-1	[5]			10%	16%
Columbia/TDRS 4	[6]	4%	5%	5%	6%
Columbia/TDRS 6	[7]				1%
Intersputnik	[8]			8%	8%
Hispasat	[9]			3%	3%
Telecom	[10]				
Fiber-Optic Cables	[11]				
Latin America	[12]	100%	100%	100%	100%
Comsat	[13]	54%	58%	51%	25%
PAS-1	[14]	46%	42%	49%	17%
PAS-3R	[15]				32%
Intersputnik	[16]				
Hispasat	[17]				
Hughes GLA	[18]				26%
U.S. Domsats	[19]				
Solidaridad/Morelos	[20]				
Anik	[21]				
Nahuelsat	[22]				
Fiber-Optic Cables	[23]				
Trans-Pacific	[24]	100%	100%	100%	100%
Comsat	[25]	96%	76%	52%	44%
PAS-2	[26]		19%	35%	43%
Columbia/TDRS 5	[27]	4%	5%	6%	8%
Intersputnik	[28]			6%	6%
JCSAT	[29]				
Fiber-Optic Cables	[30]				
Total for All Regions	[31]	100%	100%	100%	100%
Comsat	[32]	80%	75%	59%	42%
PanAmSat	[33]	17%	21%	23%	31%
Orion	[34]			6%	8%
Columbia	[35]	3%	4%	4%	5%
Intersputnik	[36]			6%	5%
Hispasat	[37]			2%	1%
Telecom	[38]				
Hughes GLA	[39]				8%
U.S. Domsats	[40]				
Solidaridad/Morelos	[41]				
Anik	[42]				
Nahuelsat	[43]				
JCSAT	[44]				
Fiber-Optic Cables	[45]				

Notes to Table SUM-2:

*1996 Estimate based on extrapolation of partial-year data.

[1], [12], [24] Total for region.

All Others = Corresponding transponder count from Table SUM-1 / Total for region from Table SUM-1.

Comsat

Table COM-1. Comsat Video and Audio Revenues and Transponder Leases
(Including Audio and Occasional-Use/Short-Term Video)

		1993	1994	1995	1996*	
Revenues: ($ Millions)						
Full-Period Video and Audio Revenues						
Trans-Atlantic	[1]	19.74	23.89	28.56	24.65	
Latin America	[2]	2.57	4.84	4.53	5.28	
Trans-Pacific	[3]	6.50	7.86	5.97	5.87	
All Regions	[4]	28.81	36.59	39.05	35.81	
Occ.-Use and Short-Term Revenues	[5]	3.76	6.23	5.54	5.99	
% of Total Revs	[6]	11.6%	14.5%	12.4%	14.3%	
Total Video and Audio Revenues (Incl. Occ. Use and Short Term)						
Trans-Atlantic	[7]	22.32	27.96	32.60	28.77	
Latin America	[8]	2.91	5.66	5.17	6.17	
Trans-Pacific	[9]	7.35	9.20	6.81	6.85	
All Regions	[10]	32.57	42.82	44.59	41.79	
Transponder Leases (27/36MHz Equivalent):						
Full-Period Video and Audio Leases (End of Year)						
Trans-Atlantic	[11]	38.8	38.3	42.8	35.6	
Latin America	[12]	9.0	11.1	9.1	11.1	
Trans-Pacific	[13]	19.0	18.0	14.0	12.3	
All Regions	[14]	66.8	67.3	65.8	58.9	
Turnover of Full-Period Leases						Total
Expired/Terminated	[15]	3.0	12.0	13.5	9.7	38.2
Expired and Renewed	[16]	8.0	5.0	3.0	6.0	22.0
New	[17]	9.0	12.6	12.0	2.8	36.3
Total Turnover	[18]	20.0	29.6	28.5	18.4	96.5
Total Full-Period Equivalent Video and Audio Leases (Incl. Occ. Use and Short Term, End of Year)						
Trans-Atlantic	[19]	43.8	44.8	48.8	41.5	
Latin America	[20]	10.2	13.0	10.4	12.9	
Trans-Pacific	[21]	21.5	21.1	16.0	14.3	
All Regions	[22]	*75.5*	78.8	75.2	68.8	

Notes to Table COM-1:

*1996 extrapolation of 1/96-8/96 data.
[1], [2], [3], [5],
[11], [12], [13],
[15], [16], [17] COMSAT
[6] =[5]/([4]+[5])
[7] =[1] x 1/(1-[6])
[8] =[2] x 1/(1-[6])
[9] =[3] x 1/(1-[6])
[19] =[11] x 1/(1-[6])
[20] =[12] x 1/(1-[6])
[21] =[13] x 1/(1-[6])

PanAmSat

Table PAN-1. PanAmSat Satellite Data Summary
(Satellites PAS 1-4 Only)

	PAS-1	PAS-2	PAS-4	PAS-3R	PAS-6	PAS-5	PAS-7	PAS-8
Region	Atlantic Ocean	Pacific Ocean	Indian Ocean	Atlantic Ocean	Atlantic Ocean	Atlantic Ocean	Indian Ocean	Pacific Ocean
Achieved/Expected Launch	June 1988	July 1994	August 1995	January 1996	December 1996	Spring 1997	Late 1997	Early 1998
Achieved/Expected Service Date	November 1988	August 1994	September 1995	February 1996	Early 1997	Mid 1997	Late 1997	Early 1998
Transponders								
Ku-Band @ 27 MHz			16					
Ku-Band @ 36 MHz					36	24	24	24
Ku-Band @ 54 MHz		12	8	12				
Ku-Band @ 64 MHz		4		4				
Ku-Band @ 72 MHz	6							
Total 27/36 MHz Ku Equiv.	12	32	32	32	36	24	24	24
C-Band @ 27 MHz								
C-Band @ 36 MHz	12					24	24	24
C-Band @ 54 MHz		12	12	12				
C-Band @ 64 MHz		4	4	4				
C-Band @ 72 MHz	6							
Total 27/36 MHz C Equiv.	24	32	32	32	0	24	24	24
Total 27/36 MHz Transponders	36	64	64	64	36	48	48	48
Usable Bandwidth	1,296	1,808	1,768	1,808	1,296	1,728	1,728	1,728
Total Output Power (Watts)	294	1,552	1,920	1,552	3,600	3,420	3,720	3,720
Estimated End of Useful Life	2001	2009	2010	2010	2012	2012	2013	2013
Estimated Coverage Area To and From the U.S.								
Ku-Band								
Trans-Atlantic	yes	--	--	--	--	--	--	--
Latin America	--	--	--	yes	yes	yes	--	--
Trans-Pacific	--	--	--	--	--	--	--	--
C-Band								
Trans-Atlantic	--	--	--	yes	--	yes	--	--
Latin America	yes	--	--	yes	--	yes	--	--
Trans-Pacific	--	yes	--	--	--	--	--	yes

Notes for Table PAN-1:

Technical data for all satellites, other than launch date, are from PanAmSat *Prospectus*, 9/25/95, p. 9.
Expected launch dates are from PanAmSat Form 10-K, 1995, p. 2; and "PAS-6 Satellite Begins Tests," *Satellite Journal International*, Vol 4, No 12.

Table PAN-2. PanAmSat Transponder Utilization by Satellite
(Satellites PAS 1-4 Only)

		Year Average				
		1993	1994	1995	1996	1997
PAS-1						
Total 27/36 MHz Ku-Band Transponders	[1]	12	12	12	12	12
Utilization Factor	[2]	*100.0%*	*100.0%*	*100.0%*	*75.0%*	*85.0%*
Utilized 27/36 MHz Ku-Band Transponders	[3]	12.0	12.0	12.0	9.0	10.2
Total 27/36 MHz C-Band Transponders	[4]	24	24	24	24	24
Utilization Factor	[5]	*100.0%*	*100.0%*	*100.0%*	*75.0%*	*85.0%*
Utilized 27/36 MHz C-Band Transponders	[6]	24.0	24.0	24.0	18.0	20.4
PAS-2						
Total 27/36 MHz Ku-Band Transponders	[7]		32	32	32	32
Utilization Factor	[8]		*13.6%*	*56.8%*	*77.7%*	*87.7%*
Utilized 27/36 MHz Ku-Band Transponders	[9]		4.4	18.2	24.9	28.1
Total 27/36 MHz C-Band Transponders	[10]		32	32	32	32
Utilization Factor	[11]		*13.6%*	*56.8%*	*77.7%*	*87.7%*
Utilized 27/36 MHz C-Band Transponders	[12]		4.4	18.2	24.9	28.1
PAS-3R						
Total 27/36 MHz Ku-Band Transponders	[13]				32	32
Utilization Factor	[14]				*66.0%*	*81.4%*
Utilized 27/36 MHz Ku-Band Transponders	[15]				21.1	26.0
Total 27/36 MHz C-Band Transponders	[16]				32	32
Utilization Factor	[17]				*66.0%*	*81.4%*
Utilized 27/36 MHz C-Band Transponders	[18]				21.1	26.0
PAS-4						
Total 27/36 MHz Ku-Band Transponders	[19]			32	32	32
Utilization Factor	[20]			*14.3%*	*57.2%*	*77.9%*
Utilized 27/36 MHz Ku-Band Transponders	[21]			4.6	18.3	24.9
Total 27/36 MHz C-Band Transponders	[22]			32	32	32
Utilization Factor	[23]			*14.3%*	*57.2%*	*77.9%*
Utilized 27/36 MHz C-Band Transponders	[24]			4.6	18.3	24.9
Summary of Transponders, PAS 1-4						
Total 27/36 MHz Transponders	[25]	36	100	164	228	228
Ku-Band	[26]	12	44	76	108	108
C-Band	[27]	24	56	88	120	120
Utilized 27/36 MHz Transponders	[28]	36.0	44.7	81.5	155.5	188.7
Ku-Band	[29]	12.0	16.4	34.8	73.3	89.2
C-Band	[30]	24.0	28.4	46.8	82.3	99.4
Percentage Utilized	[31]	100.0%	44.7%	49.7%	68.2%	82.7%

Notes to Table PAN-2:

[1], [4], [7], [10], [13], [16], [19], [22]	See Table PAN-1, corresponding row and column.
[2], [5]	Based on full utilization of PAS-1 in 1993. Decreased utilization of PAS-1 in 1996 and 1997 due to transfer of some transponder leases to PAS-3R.
[8], [11], [14], [17], [20], [23]	First year utilization factor for each satellite is calculated to be consistent with total revenues. Subsequent utilization rates are phased-in assuming 50% utilization after the first year of operation, 75% utilization after the second year; consequent increments of 10% per year until full utilization. (Consistent with the four to five year phase-in noted in PanAmSat *Prospectus*, 9/25/95, p. A-4.) PAS-3R is phased in based on the original launch date of December 1994 (Operational by end of January 1996).
[3], [6], [9], [12], [15], [18], [21], [24]	= Total 27/36 MHz Transponders x Utilization Factor.
[31]	=[28]/[25]

Table PAN-3. Transponder Allocation Factor by Service Type

Average Video Revenue per 27/36 MHz Transponder, Ku Band	1.55 [A]
Average Video Revenue per 27/36 MHz Transponder, C Band	1.25 [B]
Percent of C Band to Ku Band Video Revenue per Transponder	81% [C]
Percent of Transponders Used for Video in 1993	66% [D]
Implied Avg. Private Networks/Telephony Revenue per 27/36 MHz Transp., Ku-Band	1.76 [E]
Implied Avg. Private Networks/Telephony Revenue per 27/36 MHz Transp., C-Band	1.42 [F]

		Year Average				
		1993	1994	1995	1996	1997
Actual and Estimated PanAmSat Revenues, PAS 1-4						
Video	[1]	32.19	38.91	83.88	179.20	
Private Networks/Telephony	[2]	18.60	24.84	32.28	42.20	
Total	[3]	50.80	63.74	116.16	221.40	
Distribution of Ku and C Transponders, PAS 1-4						
Total 27/36 MHz Transponders	[4]	36.0	100.0	164.0	228.0	
Utilized 27/36 MHz Transponders	[5]	36.0	44.7	81.5	155.5	
Ku-Band	[6]	12.0	16.4	34.8	73.3	
C-Band	[7]	24.0	28.4	46.8	82.3	
Transponder Utilization, Year Average, PAS 1-4						
Video	[8]	23.8	28.6	60.9	128.8	*156.2*
Private Networks/Telephony	[9]	12.2	16.1	20.7	26.7	*32.4*
Total	[10]	36.0	44.7	81.5	155.5	*188.7*
Percent Utilized	[11]	100.0%	44.7%	49.7%	68.2%	*82.7%*
Transponder Allocation Factor, PAS 1-4						
Video	[12]	66.2%	64.0%	74.7%	82.8%	82.8%
Private Networks/Telephony	[13]	33.8%	36.0%	25.3%	17.2%	17.2%
Total	[14]	100%	100%	100%	100%	100%

Notes to Table PAN-3:

[A], [B] Based on pricing information from PanAmSat ratecard.

[C] = [B]/[A]

[D] $= \frac{[1]}{([A] \times [6] + [B] \times [7])}$ (Using 1993 Data)

[E] $= \frac{[2]}{([6] \times (1-[D]) + [C]x[7]x(1-[D])}$ (Using 1993 Data)

[F] = [E]x[C]

[1], [2] 1989-1992 revenues from the PanAmSat Form S-1, 5/25/93, p. 19.
1993-1994 revenues from the PanAmSat *Prospectus*, 9/25/95, p. 28.
1995 revenues from the PanAmSat Form 10-K, 1995, p. 34.
1996 revenues: See Table PAN-5a.

[3] =[1]+[2]

[4], [5], [6], [7] See Table PAN-2

[8] $= \frac{[1]}{([A]x[6]/[5] + [B]x[7]/[5]}$

[9] $= \frac{[2]}{([E]x[6]/[5] + [F]x[7]/[5]}$

[11] = [10]/[4]

[12] = [8]/[10]; 1997 allocation assumed to be same as 1996 figures.

[13] = [9]/[10]; 1997 allocation assumed to be same as 1996 figures.

Table PAN-4. Transponder Utilization by Satellite and Service Type

(Satellites PAS 1-4 Only)

		Year Average				
		1993	1994	1995	1996	1997
PAS-1						
Utilized 27/36 MHz Ku-Band Transp.	[1]	12.0	12.0	12.0	9.0	10.2
Video	[2]	7.9	7.7	9.0	7.5	8.4
Private Networks/Telephony	[3]	4.1	4.3	3.0	1.5	1.8
Utilized 27/36 MHz C-Band Transp.	[4]	24.0	24.0	24.0	18.0	20.4
Video	[5]	15.9	15.4	17.9	14.9	16.9
Private Networks/Telephony	[6]	8.1	8.6	6.1	3.1	3.5
PAS-2						
Utilized 27/36 MHz Ku-Band Transp.	[7]		4.4	18.2	24.9	28.1
Video	[8]		2.8	13.6	20.6	23.2
Private Networks/Telephony	[9]		1.6	4.6	4.3	4.8
Utilized 27/36 MHz C-Band Transp.	[10]		4.4	18.2	24.9	28.1
Video	[11]		2.8	13.6	20.6	23.2
Private Networks/Telephony	[12]		1.6	4.6	4.3	4.8
PAS-3R						
Utilized 27/36 MHz Ku-Band Transp.	[13]				21.1	26.0
Video	[14]				17.5	21.6
Private Networks/Telephony	[15]				3.6	4.5
Utilized 27/36 MHz C-Band Transp.	[16]				21.1	26.0
Video	[17]				17.5	21.6
Private Networks/Telephony	[18]				3.6	4.5
PAS-4						
Utilized 27/36 MHz Ku-Band Transp.	[19]			4.6	18.3	24.9
Video	[20]			3.4	15.1	20.6
Private Networks/Telephony	[21]			1.2	3.1	4.3
Utilized 27/36 MHz C-Band Transp.	[22]			4.6	18.3	24.9
Video	[23]			3.4	15.1	20.6
Private Networks/Telephony	[24]			1.2	3.1	4.3
Summary of Transponders, PAS 1-4						
Utilized 27/36 MHz Ku-Band Transp.	[25]	12.0	16.4	34.8	73.3	89.2
Video	[26]	7.9	10.5	26.0	60.7	73.9
Private Networks/Telephony	[27]	4.1	5.9	8.8	12.6	15.3
Utilized 27/36 MHz C-Band Transp.	[28]	24.0	28.4	46.8	82.3	99.4
Video	[29]	15.9	18.1	34.9	68.1	82.3
Private Networks/Telephony	[30]	8.1	10.2	11.8	14.1	17.1
Total Utilized 27/36 MHz Transp.	[31]	36.0	44.7	81.5	155.5	188.7
Video	[32]	23.8	28.6	60.9	128.8	156.2
Private Networks/Telephony	[33]	12.2	16.1	20.7	26.7	32.4

Notes to Table PAN-4:

[1], [4], [7], [10], [13], [16], [19], [22] See Table PAN-2.
[2], [5], [8], [11], [14], [17], [20], [23] = Total utilized transponders x Table PAN-3, [12]
[3], [6], [9], [12], [15], [18], [21], [24] = Total utilized transponders x Table PAN-3, [13]